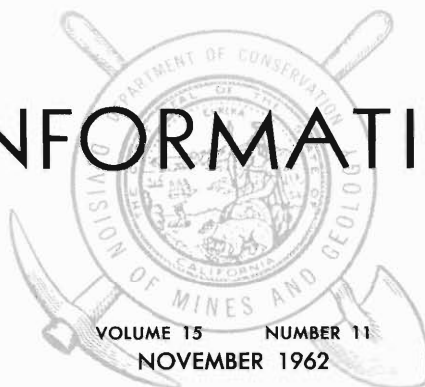


MINERAL INFORMATION SERVICE

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DIVISION OF MINES AND GEOLOGY

Vitreous Silica

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Vitreous silica is the glassy form of silicon dioxide and is obtained by melting a pure crystalline form of silica such as quartz or silica sand. Because of its resistance to thermal shock, high softening point, high strength, and transparency to ultraviolet light, it is an ideal material for many purposes. It has been used in Europe for a long time, but the vitreous silica industry has developed in the United States only since the beginning of World War II. Today, sales in the United States are estimated to be \$27 million a year.

The utilization of vitreous silica has been restricted because it is difficult to produce and work. Almost all other glasses are silicate glasses that contain two or more other oxides such as soda, lime, alumina, or boric oxide, that are added to the silica to lower the melting point and to make them more workable.

Terminology of the Vitreous Silica Industry

One principal type of vitreous silica is transparent and has optimum physical properties. It is made from fragments of transparent quartz of the highest purity available. Other types, which are made from high-quality silica sand, are translucent, opaque, or have an outer surface with a sandy texture.

The terms used by the vitreous silica industry are confusing. Ladoo suggested the terms fused quartz for the transparent type and fused silica for the opaque and translucent types, but all types commonly are referred to as fused quartz. Consequently, it is necessary to use a cumbersome term such as clear fused quartz for the transparent type.

The term fused quartz is objectionable to some people who feel that because quartz is crystalline, the term quartz should not be associated with a glass. Another term that sometimes is used for the transparent type is quartz glass, but it likewise is contradictory and technically unsound. Moreover, even technical writers tend to drop the term glass, leaving the reader unsure if crystalline or vitreous silica is referred to.

Opaque and translucent vitreous silica of several types are commonly called fused quartz or fused sil-

ica and are also known by trade or brand names such as Amersil and Vitreosil. Vitreosil is made in an electric furnace from high-purity silica sand or quartz crushed to sand size. Sand is packed into a graphite-lined box containing an electrically heated, graphite core, the heat from which fuses the sand that immediately surrounds it. After the fusion has cooled, the unfused material is removed, and the core is withdrawn, leaving a tube of fused quartz. The tube is then reheated and worked. Fused quartz that has been made in this way contains a myriad of tiny bubbles that cannot be removed, as well as the impurities present in the original sand grains. Its physical and chemical properties are therefore somewhat inferior to those of clear fused quartz, but it is useful for making articles for high temperature work such as insulators and combustion tubes where transparency is not important.

Vycor brand glass of the Corning Glass Works is a transparent glass containing 96 percent silica. Although not truly vitreous silica, it approaches it in most physical properties and has many of the same applications. An alkali-borosilicate glass is subjected to a heat treatment that causes the glass to separate into a soluble, alkali-boric oxide phase and a silica-rich phase containing a little boric oxide. The soluble phase is leached away with acid, leaving a porous glass; a second heat treatment shrinks the glass and closes the pores.

Utilization of Clear Fused Quartz

The transparency, strength, high thermal resistance, and resistance to thermal shock of clear fused quartz make it ideal for laboratory glassware, windows in reaction vessels, output windows for electronic tubes, and observation windows for space vehicles. It also is inert to most chemicals except alkalies and has high electrical resistance.

Clear fused quartz is remarkably transparent, not only to visible light, but also to infrared and ultraviolet radiation. It has the highest transmission of visible and ultraviolet radiation of any material known